Epitomes

Important Advances in Clinical Medicine

Anesthesiology

The Council on Scientific Affairs of the California Medical Association presents the following inventory of items of progress in anesthesiology. Each item, in the judgment of a panel of knowledgeable physicians, has recently become reasonably firmly established, both as to scientific fact and important clinical significance. The items are presented in simple epitome, and an authoritative reference, both to the item itself and to the subject as a whole, is generally given for those who may be unfamiliar with a particular item. The purpose is to assist busy practitioners, students, researchers, and scholars to stay abreast of these items of progress in anesthesiology that have recently achieved a substantial degree of authoritative acceptance, whether in their own field of special interest or another.

The items of progress listed below were selected by the Advisory Panel to the Section on Anesthesiology of the California Medical Association, and the summaries were prepared under its direction.

Reprint requests to Division of Scientific and Educational Activities, California Medical Association, PO Box 7690, San Francisco, CA 94120-7690

Transesophageal Echocardiography

TRANSESOPHAGEAL ECHOCARDIOGRAPHY offers a new perspective on the heart. With the introduction of smaller, more sophisticated transducers and the addition of color-flow Doppler and biplanar imaging, transesophageal echocardiography has become widely accepted as a low-risk method for the rapid, accurate examination of myocardial function, valvular disease, and aortic anatomy.

In skilled hands, transesophageal echocardiography is considered safe, with a low (<1%) incidence of complications such as arrhythmias, hypotension, bronchospasm, and aspiration. The most catastrophic complication, esophageal rupture, is extremely rare and has been reported only in patients with esophageal disease or carcinoma; transesophageal echocardiography is contraindicated in these cases. The procedure is also proscribed in nonfasting patients and in those with severe bleeding diathesis.

Although transesophageal and transthoracic imaging are based on the principles of ultrasonography, transesophageal echocardiography is superior in most cases. The retrocardiac approach produces higher resolution images, avoids tissues, improves ultrasound transmission, and avoids the necessity of interrupting a thoracic procedure for imaging. Finally, the location affords excellent visualization of both valvular prostheses and aortic anatomy. In fact, because it does not require a contrast medium and can be done at the bedside, transesophageal echocardiography may be preferable to computed tomography and angiography for evaluating aortic dissection in centers with adequate facilities and experienced staffs.

In the past several years, anesthesiologic and critical care uses for transesophageal echocardiography have expanded rapidly. Preoperatively, it is useful for evaluating baseline cardiac performance and valvular anatomy and can define intracardiac vegetations, masses, and thrombi with exquisite detail. Postoperatively, it can complement other monitoring methods in the intensive care unit to follow hemodynamics and cardiac function.

Intraoperative transesophageal imaging is now routinely done during cardiac and high-risk operations in many centers. Transesophageal echocardiography can detect myocardial ischemia at its earliest observable stage, when ventricular relaxation becomes impaired and regional wall motion abnormalities occur. These changes are seen before electrocardiographic ST segment shifts and provide the opportunity to promptly recognize and treat intraoperative ischemia. In addition, pulsed-wave Doppler examination of pulmonary venous flow may help predict changes in pulmonary capillary wedge pressure and associated volume shifts. Finally, transesophageal echocardiography is often invaluable for the intraoperative assessment of valvular insufficiency, repair, and replacement. All of these benefits depend on physicians' experience and procedural skill. Many transesophageal echocardiography determinants are semiquantitative in nature, and thorough training in echocardiography is essential to avoid misinterpretations.

Several recent advances are important to note. Biplanar transesophageal echocardiography probes with two orthogonally arranged crystal arrays were introduced several years ago and allow both transverse and longitudinal cross-sectional imaging of the heart. In the near future, multiplanar probes with electronically adjustable transducer angulation will become generally available. These will permit visualizing almost any imaging plane and will compensate for a lack of probe flexibility within the esophagus.

Echocardiographic contrast material for intravascular and intracardiac administration is now being commercially produced. This fluid is extremely "echo-dense" and reflects ultrasound waves efficiently, even at relatively low concentrations. Echocardiographic contrast can be administered to the right or left ventricle to enhance endocardial border definition and can also be infused intraoperatively into coronary arteries or bypass grafts. In the latter cases, the contrast is carried into the myocardium, which then becomes noticeably brighter on echocardiographic imaging. This is a promising new technique to assess the patency of coronary bypass grafts before the operation is completed and the chest is closed.

A development called acoustic quantification is also now available. With this technology, endocardial borders in a region of interest are automatically defined and enhanced, and real-time changes in left or right ventricular cross-sectional areas can be instantaneously calculated and displayed. With advanced instruments, ultrasonic tissue characteristics of the myocardium can also be studied. This may prove useful in assessing cardiac performance, intrinsic myocardial abnormalities, and, indirectly, ventricular stroke volumes. The combination of multiplanar imaging and acoustic quantification could ultimately lead to clinically practical three-dimensional imaging of the heart.

TIMOTHY L. FENG
DANIEL G. BLANCHARD, MD
San Diego, California

REFERENCES

Cahalan MK: Intraoperative monitoring, chap 10, *In* Dittrich HC (Ed): Clinical Transesophageal Echocardiography. St Louis, Mo, Mosby-Year Book, 1992, pp 141-148

Lee E, Schiller NB: Ambulatory and intraoperative transesophageal echocardiography. Cardiol Clin 1989; 7:511-524

Matsuzaki M, Toma Y, Kusukawa R: Clinical applications of transesophageal echocardiography. Circulation 1990; 82:709-722

New Applications of Propofol

SINCE ITS INTRODUCTION IN 1989, propofol has rapidly become popular for inducing and maintaining anesthesia. Propofol has two unusual characteristics that account for this popularity. On the pharmacokinetic side, propofol has a rapid clearance, 1.5 to 2 liters per minute, which exceeds hepatic blood flow. Propofol is also highly fat soluble and sequesters in fat following long infusions. These pharmacokinetic properties result in a rapid decrease in propofol concentration following continuous infusions, regardless of the infusion duration. On the pharmacodynamic side, subhypnotic doses of propofol do not cloud consciousness. The net effect is that patients recover rapidly at the end of long infusions.

The US Food and Drug Administration this year approved the use of propofol for "monitored anesthesia care sedation." In this situation, propofol, when compared with midazolam hydrochloride, allows a more rapid titration to the level of sedation and a faster return of clearheadedness. The more rapid blood-brain equilibration of propofol (1 to 2 minutes) compared with midazolam (2 to 4 minutes) means that the level of consciousness can be more rapidly decreased with propofol in anticipation of an imminent noxious stimulus. Once the stimulus is over, the patient can be returned to a lighter level of sedation more rapidly with propofol than with midazolam. This is particularly important if the patient must occasionally interact with the surgeon. Older patients sometimes become excited with the use of midazolam, but not with propofol. Like midazolam, propofol is a potent ventilatory depressant, particularly when combined with opioids. Therefore, the use of propofol for sedation is recommended only when administered by anesthesiologists or other personnel who have been trained in acute airway management.

Propofol is also being investigated for the long-term sedation of intubated patients in intensive care units. The current standard in many hospitals is a continuous infusion of midazolam and an opioid. This regimen results in a substantial accumulation of midazolam and prolonged sedation when the infusion is terminated. The high clearance of propofol permits a rapid decrease in propofol concentrations, even after infusions of one to two weeks. This allows for awakening a patient at regular intervals for the frequent assessment of neurologic status. Provided that the patient has adequate cardiac filling pressures and that judicious titration is used to achieve the appropriate level of sedation, propofol used for sedation in the intensive care unit is usually not associated with the hypotension that accompanies the induction of anesthesia in an operating room. Additional benefits of using propofol in critically ill patients are a decreased metabolic oxygen requirement, with a concomitant increase in mixed venous oxygen saturation, and little need for vasodilators or negative inotropes in hyperdynamic patients. As propofol has no intrinsic analgesic properties, it is helpful to give a small amount of an opioid concurrently. This reduces the amount of propofol required to produce the desired level of sedation.

Propofol also appears to have antiemetic properties. Many of the initial clinical studies documented a low incidence of nausea and vomiting following propofol anesthesia. In several recent studies, propofol was found to be effective in treating chemotherapy-induced emesis. The propofol concentrations that appear effective in treating nausea are well below those associated with sedation.

STEVEN L. SHAFER, MD
Palo Alto, California

REFERENCES

Borgeat A, Wilder-Smith OH, Saiah M, Rifat K: Subhypnotic doses of propofol possess direct antiemetic properties. Anesth Analg 1992; 74:539-541

Shafer A, Doze VA, White PF: Pharmacokinetic variability of midazolam infusions in critically ill patients. Crit Care Med 1990; 18:1039-1041

Shelly MP, Sultan MA, Bodenham A, Park GR: Midazolam infusions in critically ill patients. Eur J Anaesthesiol 1991; 8:21-27

Sher C, McDowall R, Barst S: Propofol for the prevention of chemotherapy induced nausea and vomiting in pediatric cancer patients (Abstr). Anesthesiology 1991; 75:A1050

'Do-Not-Resuscitate' Orders in Operating Rooms

PATIENTS WITH "do-not-resuscitate" (DNR) orders may come to operating rooms for procedures to palliate symptoms. They also may need operations to treat lesions related or unrelated to the disease that led to the DNR decision. How is the DNR status to be handled by operating room personnel? This is an important question because common interventions in operating rooms could be labeled resuscitation in other settings. It may be difficult to separate resuscitation required to reverse acute anesthesia- or surgery-related problems from that needed to reverse events caused by the underlying disease.

At least four options exist for dealing with DNR orders perioperatively:

- Allow the preoperative DNR order to stand, but suspend the DNR order during and soon after the operative period. In this instance DNR plans can be reinstituted when the patient has recovered from the acute effects of anesthesia;
- Life-sustaining measures instituted intraoperatively can be withdrawn postoperatively. For example, if a patient has become ventilator dependent, an agreement to discontinue such treatment can be documented preoperatively;
- Provide all resuscitative measures short of cardiac massage;
- Suspend DNR orders but reinstate them intraoperatively if cardiac arrest occurs related to the disease that led to the DNR orders, such as hypovolemic shock during a portacaval shunt in a patient with advanced cirrhosis and encephalopathy.

In recent lively and thoughtful debates about DNR orders in patients requiring surgical treatment, each of the above options or blends of these options has been proposed. Federal law (Patient Self-Determination Act of 1990) requires that patients entering institutions receiving Medicare or Medicaid funds must be advised of their right to issue advanced